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DEPARTMENT OF MATERIALS CHEMISTRY
Industrial Materials Section

CONTRACT REPORT NO. OSQ79-00129

PORE SIZE DISTRIBUTION OF MORTAR SAMPLES BY MERCURY POROSIMETRY

Image Analysis Services
Report No. QS 335-79-1

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A. J. Terry
March 10, 1980

for

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Attention: E. E. Berry

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1. INTRODUCTION

Thirty samples of mortar were received at ORF to determine their pore size distributions using mercury porosimetry. This work has been arranged under DSS contract number 0S079-00128.

2. DESCRIPTION OF ANALYTICAL METHOD

2.1 Sample Handling

Samples were received from the CANMET labs at intervals corresponding to 3, 7, 14, 30 and 91 days after preparation. Vertical slices of approximate thickness 5mm were cut from the middle of the 3 cubes comprising each sample. The middle portion (25mm x 25mm) from each slice was broken into 3-5 sections and dried at 35°C under vacuum for 17 hours. Sections from each slice were then combined and taken for analysis. Both series of samples were handled in the same manner.

2.2 Pore Size Analysis

The Aminco 60,000 psi Mercury Intrusion Porosimeter used to perform these measurements is capable of determining pore size within the range 180 to 0.003 μm. It operates on the principle that when mercury is forced into a pore in a solid material, the pressure required to fill the pore completely is in inverse proportion to the size of the pore. The relationship is

$$pr = 2Q \cos \Theta$$

where p is the pressure, r the pore radius, Q the surface tension of the mercury and Θ the contact angle of mercury with the solid. Since

Q and θ are both assumed to remain constant, application of a known pressure yields the corresponding pore dimension. Precise measurement of mercury volume changes, as a known amount of mercury is intruded into the pores of the material by increasing pressure, indicates the volume of pores of a given size. The value of the contact angle θ varies somewhat with different materials and an average value of 130° is most often used. The surface tension, Q, of mercury was taken as being 473 dynes/cm. With suitable conversion factors, these values substituted into the above equation result in the relationship

$$D = \frac{175}{P}$$

where D is the pore diameter in microns and P is the absolute pressure in psia.

3. RESULTS

Tables I to IX provide listings of the absolute penetration (cc/g) for each of the samples. This data is represented graphically in figures 1 to 9. A summary of the results for each series of samples is given in Tables X and XI.

A. J. Terry
Technologist II

R. B. Bruce
Associate Research Scientist

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TABLE I

SERIES I DAYS AGED = 3

0% SLAG					40% SLAG					60% SLAG				
	PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)			PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		
	182.292		0.0000		182.292		0.0000			182.292		0.0000		
	95.109		0.0038		97.948		0.0013			96.507		0.0025		
	77.206		0.0051		79.066		0.0026			78.125		0.0037		
	53.571		0.0051		54.461		0.0026			53.791		0.0043		
	40.761		0.0064		41.535		0.0026			41.016		0.0049		
	33.060		0.0064		33.568		0.0026			33.144		0.0055		
	27.807		0.0064		28.105		0.0033			27.807		0.0062		
	23.995		0.0064		24.171		0.0039			23.995		0.0062		
-14	21.034		0.0076		21.238		0.0039			21.101	0	0.0062		
-1 -21	18.750		0.0083	6	18.939		0.0039			18.831	6	0.0062	75	
-15	17.955		0.0089	6	18.103		0.0052			18.004	(171)	0.0074	63	
+219	5.036	90	0.0096	16	5.048	93	0.0063			1.595	(197)	0.0405	337	
	2.929	87	0.0121	37	2.933	88	0.0115			1.096	31	0.0468	221	
+277	234 1.595	82	0.0171	42	1.596	78	0.0214			0.834	20	0.0508	207	
+27	262 1.095	78	0.0206	37	1.096	70	0.0285			0.565	32	0.0572	163	
-3	263 0.834	74	0.0245	36	0.835	66	0.0325			0.427	22	0.0616		
	0.674		0.0278	34	0.565	61	0.0377			0.343	29	0.0648	171	
+6	257 0.565	66	0.0313	50	0.343	54	0.0444			0.287	25	0.0675		
+35	267 0.343	61	0.0379	57	0.230	47	0.0495			0.247	21	0.0699		
	0.230	54	0.0427	41	0.173	44	0.0539			0.216	19	0.0717		
+4	294 0.173	51	0.0461	73	0.087	31	0.0667			0.192	19	0.0738		
-66	273 0.087	38	0.0574	107	0.058	24	0.0729			0.173	38	0.0755	164	
-55	278 0.058	28	0.0674	83	0.044		0.0758			0.116	46	0.0815		
-14	218 0.035	21	0.0741	45	0.035	20	0.0773			0.087	43	0.0847	148	
-6	214 0.029	18	0.0764	18	0.029	18	0.0793			0.058	45	0.0902	134	
+1	217 0.025		0.0777	11	0.025		0.0806			0.044	28	0.0937		
+5	215 0.022	16	0.0786	9	0.022	15	0.0817			0.035	20	0.0959	129	
+1	217 0.019	15	0.0795	8	0.019	14	0.0827			0.029	15	0.0978	126	
+4	224 0.017	14	0.0803	20	0.017	4	0.0834			0.025	11	0.0989	127	
+1	226 0.012	11	0.0835	27	0.012	11	0.0861			0.022	11	0.1001	127	
+24	231 0.009	8	0.0857	22	0.009	8	0.0884			0.019	13	0.1012	127	
+25	238 0.006	6	0.0879	20	0.006	6	0.0911			0.017	24	0.1027	127	
+2	256 0.004	4	0.0897	18	0.004	4	0.0931			0.012	30	0.1061	127	
	0.003		0.0915	18	0.003		0.0951			0.009	33	0.1088	127	
	2500.003	0	0.0933		0.003		0.0964			0.006	32	0.1127	128	
										0.004	23	0.1153	128	
										0.003	150	0.1173	126	
										0.003		0.1183	127	

Department of Energy, Mines & Resources
Report No. QS 335-79-1

TABLE II

SERIES I DAYS AGED = 7

		0% SLAG		40% SLAG		60% SLAG	
		PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)
		182.292	0.0000	182.292	0.0000	182.292	0.0000
		98.684	0.0005	95.109	0.0035	97.948	0.0012
		80.031	0.0011	77.663	0.0041	79.545	0.0018
		54.688	0.0016	53.571	0.0047	54.461	0.0024
		41.535	0.0022	40.888	0.0053	41.404	0.0030
		33.568	0.0032	33.144	0.0053	33.397	0.0037
		28.165	0.0032	27.807	0.0059	28.045	0.0037
		24.216	0.0027	23.951	0.0065	24.171	0.0037
	4	21.238	0.0033	21.067	0.0065	21.238	0.0037
+7	5	18.912	0.0038	18.777	0.0071	18.912	0.0043
+16	11	18.128	0.0038	17.979	0.0077	18.103	0.0049
+29	21	5.050	0.0054	5.038	0.0147	5.048	0.0075
+50	40	2.934	0.0064	2.930	0.0172	2.933	0.0104
+46	71	2.067	0.0073	2.065	0.0195	2.067	0.0144
+50	86	1.596	0.0088	1.595	0.0261	1.596	0.0174
+65	121	1.096	0.0110	1.096	0.0288	1.096	0.0231
		0.835	0.0134	0.834	0.0302	0.674	0.0305
+26	161	0.674	0.0154	0.565	0.0325	0.565	0.0321
+6	147	0.427	0.0191	0.427	0.0363	0.427	0.0338
+1	157	0.343	0.0207	0.343	0.0384	0.343	0.0364
+7	148	0.287	0.0227	0.230	0.0420	0.287	0.0375
		0.247	0.0237	0.173	0.0451	0.230	0.0417
		0.216	0.0247	0.087	0.0540	0.173	0.0452
		0.204	0.0260	0.058	0.0608	0.116	0.0510
		0.192	0.0275	0.044	0.0649	0.087	0.0551
+11	164	0.173	0.0288	0.035	0.0675	0.058	0.0601
+14	159	0.116	0.0351	0.029	0.0701	0.044	0.0640
+2	176	0.087	0.0373	0.025	0.0718	0.035	0.0665
-35	141	0.058	0.0440	0.022	0.0730	0.029	0.0683
-27	143	0.044	0.0497	0.019	0.0738	0.025	0.0709
-15	134	0.035	0.0531	0.017	0.0750	0.022	0.0723
+8	128	0.029	0.0555	0.012	0.0791	0.019	0.0728
+10	142	0.025	0.0567	0.009	0.0817	0.017	0.0755
-9	138	0.022	0.0585	0.006	0.0856	0.012	0.0816
+9	131	0.019	0.0597	0.004	0.0887	0.009	0.0853
+41	147	0.017	0.0608	0.003	0.0915	0.006	0.0905
+35	172	0.012	0.0644	0.003	0.0942	0.004	0.0938
+29	184	0.009	0.0671			0.003	0.0964
+28	201	0.006	0.0704			0.003	0.0986
+9	210	0.004	0.0728				
		0.003	0.0752				
	210	0.003	0.0776				

Department of Energy, Mines & Resources
Report No. QS 335-79-1

TABLE III

SERIES I DAYS AGED = 14

	0% SLAG		40% SLAG		60% SLAG	
	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)
	182.292	0.0000	182.292	0.0000	182.292	0.0000
	98.684	0.0006	97.948	0.0010	98.684	0.0005
	80.031	0.0011	80.031	0.0010	80.031	0.0010
	54.916	0.0011	54.688	0.0016	54.916	0.0010
	41.667	0.0017	41.535	0.0021	41.799	0.0010
	33.611	0.0020	33.568	0.0021	33.654	0.0016
	28.165	0.0022	28.165	0.0021	28.165	0.0021
	24.261	0.0022	24.261	0.0021	24.216	0.0026
9	21.307	0.0022	21.307	0.0021	21.238	0.0031
+10 14	18.994	0.0022	18.994	0.0021	18.912	0.0036
+4 19	18.204	0.0022	18.204	0.0021	18.103	0.0041
+23 18	5.056	0.0032	5.056	0.0054	5.048	0.0050
+46 42	2.936	0.0039	2.936	0.0071	2.933	0.0081
+46 64	2.068	0.0046	2.068	0.0091	2.067	0.0110
+60 88	1.597	0.0052	1.597	0.0101	1.596	0.0140
+41 124	1.096	0.0068	1.096	0.0137	1.096	0.0192
+3 129	0.835	0.0096	0.835	0.0164	0.835	0.0225
-35 127	0.565	0.0117	0.565	0.0214	0.565	0.0244
-26 104	0.427	0.0155	0.427	0.0259	0.427	0.0259
-30 101	0.343	0.0179	0.343	0.0286	0.343	0.0280
-45 74	0.287	0.0211	0.287	0.0326	0.287	0.0285
-26 56	0.247	0.0236	0.247	0.0345	0.247	0.0292
-18 46	0.216	0.0248	0.216	0.0361	0.216	0.0296
-11 38	0.192	0.0269	0.192	0.0372	0.192	0.0307
-6 29	0.173	0.0289	0.173	0.0383	0.173	0.0318
+22 72	0.087	0.0342	0.087	0.0433	0.087	0.0374
+23 61	0.058	0.0376	0.058	0.0473	0.058	0.0427
+27 87	0.044	0.0400	0.044	0.0499	0.044	0.0487
0 79	0.035	0.0432	0.035	0.0515	0.035	0.0511
+7 87	0.029	0.0456	0.029	0.0537	0.029	0.0543
-1 96	0.025	0.0471	0.025	0.0555	0.025	0.0557
+6 86	0.022	0.0483	0.022	0.0570	0.022	0.0569
+13 92	0.019	0.0499	0.019	0.0584	0.019	0.0591
+29 99	0.017	0.0505	0.017	0.0595	0.017	0.0604
+74 121	0.012	0.0542	0.012	0.0643	0.012	0.0663
+87 173	0.009	0.0568	0.009	0.0683	0.009	0.0741
+63 208	0.006	0.0605	0.006	0.0746	0.006	0.0813
+27 216	0.004	0.0637	0.004	0.0802	0.004	0.0873
	0.003	0.0667	0.003	0.0844	0.003	0.0903
2350	0.003	0.0695	0.003	0.0876	0.003	0.0930

TABLE IV

SERIES I DAYS AGED = 30

0% SLAG				40% SLAG		60% SLAG		
	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	
	182.292	0.0000		182.292	0.0000	182.292	0.0000	
	95.803	0.0029		99.432	0.0000	99.432	0.0000	
	78.125	0.0034		80.031	0.0011	80.031	0.0010	
	53.791	0.0040		54.688	0.0016	54.688	0.0016	
	41.016	0.0046		41.535	0.0021	41.535	0.0021	
	33.228	0.0046		33.568	0.0021	33.568	0.0021	
	27.926	0.0046		28.165	0.0021	28.165	0.0021	
	24.083	0.0046		24.261	0.0021	24.261	0.0021	
−20	21.169	2 0.0046		21.307	0.0021	21.272	0.0026	
0 −20	18.858	2 0.0051	61	18.994	0.0021	18.939	0.0031	61
−4 −20	18.079	2 0.0051		18.179	0.0027	18.154	0 0.0031	
−4 −24	5.046	5 0.0055	57	5.054	0.0038	5.052	3 0.0031	56
+14 −24	2.932	7 0.0062	51	2.935	0.0049	2.934	14 0.0038	61
+6 −30	2.067	13 0.0070		2.068	0.0068	2.068	16 0.0060	86
−30 −53	1.596	38 0.0088	51	1.596	0.0092	1.596	23 0.0070	90
−23 −40	0.835	40 0.0147	60	0.835	0.0147	0.835	29 0.0107	73
+1 −41	0.565	22 0.0169	54	0.565	0.0177	0.565	22 0.0128	76
−11 −37	0.427	21 0.0191		0.427	0.0200	0.427	16 0.0152	90
−27 −52	0.343	22 0.0212	56	0.343	0.0228	0.343	9 0.0160	75
−8 −66	0.287	17 0.0236		0.287	0.0253	0.287	8 0.0170	72
−2 −60	0.247	13 0.0247		0.247	0.0274	0.247	12 0.0187	76
−16 −68	0.216	15 0.0263		0.216	0.0285	0.216	7 0.0195	74
−7 −76	0.192	12 0.0277		0.192	0.0295	0.192	8 0.0201	73
+2 −78	0.173	26 0.0287	62	0.173	0.0300	0.173	27 0.0212	74
+17 −80	0.087	31 0.0329	57	0.087	0.0337	0.087	40 0.0255	78
+29 −82	0.058	18 0.0350	52	0.058	0.0357	0.058	32 0.0292	93
+24 −82	0.044	14 0.0365		0.044	0.0375	0.044	26 0.0320	99
+20 −84	0.035	15 0.0378	51	0.035	0.0388	0.035	25 0.0344	91
+15 −85	0.029	14 0.0395	52	0.029	0.0401	0.029	22 0.0370	94
+13 −11	0.025	11 0.0407	52	0.025	0.0412	0.025	18 0.0388	95
+16 −10	0.022	8 0.0417	53	0.022	0.0424	0.022	16 0.0407	98
+12 −3	0.019	7 0.0423	53	0.019	0.0436	0.019	13 0.0420	99
+41 2	0.017	18 0.0432	54	0.017	0.0445	0.017	39 0.0434	101
+62 3	0.012	26 0.0460	55	0.014	0.0469	0.012	56 0.0498	104
+64 64	0.009	29 0.0482	56	0.012	0.0492	0.009	71 0.0546	113
+95 122	0.006	33 0.0519	59	0.009	0.0528	0.006	81 0.0641	124
+31 169	0.004	33 0.0549	61	0.006	0.0595	0.004	60 0.0708	129
	0.003	44 0.0585		0.004	0.0663	0.003	41 0.0761	
	153 0.003	0.0638	68	0.003	0.0717	0.003	0.0791	124
				0.003	0.0759			

TABLE V

SERIES I DAYS AGED = 91

0% SLAG				40% SLAG				60% SLAG			
PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)	
182.292		0.0000		182.292		0.0000		182.292		0.0000	
99.432		0.0000		98.684		0.0006		94.425		0.0039	
80.031		0.0010		80.031		0.0012		77.206		0.0044	
54.688		0.0015		54.461		0.0023		53.354		0.0050	
41.535		0.0020		41.404		0.0029		40.761		0.0056	
33.568		0.0020		33.482		0.0029		33.060		0.0056	
28.165		0.0020		28.105		0.0029		27.748		0.0061	
24.261		0.0020		24.171		0.0035		23.951		0.0061	
21.272		0.0025		21.238		0.0035		21.067		0.0061	
18.967		0.0025		18.939		0.0035		18.777	30	0.0067	264 118
18.179	96	0.0025	32	18.154	96	0.0035		18.004	11	0.0067	96 91
5.054	13	0.0042	44	5.052	935	0.0055		5.040	16	0.0089	212
2.935		0.0055	45	2.934		0.0070		2.930	14	0.0100	182
2.068	44	0.0064		2.068	90	0.0082		2.066	17	0.0117	182
1.596		0.0077	45	1.596		0.0097		1.595	14	0.0134	174 33
1.096	41	0.0115	56	1.096	46	0.0120		1.096	11	0.0145	126 31
0.746		0.0153		0.835		0.0147		0.834	14	0.0157	103 31
0.565	70	0.0180	58	0.565	76	0.0182		0.565	21	0.0173	80 30
0.427		0.0215		0.427		0.0241		0.427	29	0.0199	90 32
0.343	54	0.0246	65	0.343	67	0.0276		0.343	9	0.0213	98 33
0.287		0.0266		0.287		0.0293		0.287	6	0.0218	92 32
0.247		0.0273		0.247		0.0311		0.247	7	0.0224	92 32
0.216		0.0281		0.216		0.0323		0.216	10	0.0232	92 32
0.192	53	0.0286		0.192	61	0.0329		0.192	11	0.0244	95 33
0.173		0.0291	63	0.173		0.0337		0.173	30	0.0255	98 34
0.116		0.0306		0.116		0.0370		0.087	31	0.0305	96 36
0.087	26	0.0316	55	0.087	26	0.0370		0.058	25	0.0333	101 37
0.058		0.0331	49	0.058		0.0390		0.044	20	0.0356	103 96
0.044	13	0.0343		0.044	21	0.0411		0.035	17	0.0373	106
0.035		0.0353	46	0.035		0.0426		0.029	16	0.0390	108
0.029		0.0361	47	0.029		0.0440		0.025	15	0.0406	110
0.025		0.0368	47	0.025		0.0449		0.022	14	0.0420	112
0.022	32	0.0376	46	0.022	10	0.0458		0.019	13	0.0435	118
0.019		0.0383	48	0.019		0.0470		0.017	37	0.0446	114
0.017		0.0391	49	0.017		0.0479		0.012	57	0.0510	122
0.012	21	0.0419	50	0.012	27	0.0526		0.009	7	0.0561	127
0.009	17	0.0441	52	0.009	22	0.0567		0.006	14	0.0656	136
0.006	20	0.0484	55	0.006	24	0.0640		0.005	4	0.0710	
0.004	13	0.0526	59	0.004		0.0722		0.004	50	0.0743	140
0.003		0.0572		0.004	9	0.0761		0.003	53	0.0811	
0.003		0.0592		0.003		0.0787		0.003		0.0850	140
0.003	6	0.0607	65	0.003	0	0.0840					

TABLE VI

SERIES II DAYS AGED = 3

0% SLAG				40% SLAG				60% SLAG				
PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		PORE SIZE (UM)		ABSOLUTE PENETRATION (CC/G)		
182.292		0.0000		182.292		0.0000		182.292		0.0000		
97.948		0.0011		98.684		0.0005		98.684		0.0005		
80.031		0.0011		80.031		0.0011		80.031		0.0010		
54.574		0.0020		54.688		0.0016		54.461		0.0021		
41.535		0.0022		41.535		0.0022		41.404		0.0026		
33.568		0.0022		33.568		0.0022		33.397		0.0031		
28.105		0.0028		28.105		0.0027		27.985		0.0036		
24.171		0.0034		24.171		0.0033		24.083		0.0041		
+7 21.204		0.0039		21.238		0.0033		21.135		0.0046		
+4 +6 18.885		0.0045	5	18.939		0.0033		18.831		0.0051	5	
+24 +11 18.103	44	0.0045	5	18.154	44	0.0033		18.029	45	0.0056	17	124
+68 +30 5.048	93	0.0055	13	5.052	94	0.0058		5.042	92	0.0085	47	195
+112 +79 2.933	91	0.0071	11	2.934	92	0.0080		2.931	85	0.0150	67	213
+187 +142 2.067		0.0077	6	2.068		0.0102		2.066		0.0219	50	284
+22 +166 1.596	89	0.0084	16	1.596	87	0.0136		1.595	76	0.0250	47	293
+73 +204 1.096	86	0.0110	19	1.096	70	0.0319		1.096	70	0.0314	56	295
+62 +237 0.835		0.0123	22	0.835		0.0360		0.834		0.0362	53	
+35 +266 0.565	80	0.0154	25	0.565	60	0.0417		0.565	59	0.0420	48	273
+20 +274 0.427		0.0184	26	0.427		0.0453		0.427		0.0458	36	
+20 +286 0.343	74	0.0207	21	0.343	63	0.0490		0.343	52	0.0493	31	238
+12 +294 0.287		0.0227	19	0.287		0.0508		0.287		0.0521	25	
+8 +298 0.247	69	0.0245	18	0.247	50	0.0525		0.247	47	0.0543	21	222
+1 +302 0.216		0.0263	16	0.216		0.0547		0.216		0.0564	20	
0 +305 0.192	65	0.0278	16	0.192	46	0.0564		0.192	43	0.0583	17	210
-17 +307 0.173	62	0.0296	67	0.173	45	0.0581		0.173	42	0.0598	34	202
-48 +268 0.087	48	0.0412	101	0.087	30	0.0736		0.116	37	0.0652	51	
-58 +254 0.058	37	0.0498	71	0.058	25	0.0791		0.087	32	0.0700	50	170
-30 +240 0.044	30	0.0554	43	0.044	22	0.0818		0.058	27	0.0752	42	81
-4 +224 0.035	26	0.0585	24	0.035	20	0.0841		0.044	24	0.0784	28	142
-1 +226 0.029	24	0.0602	18	0.029	19	0.0858		0.035	21	0.0809	22	138
-2 +225 0.025		0.0621	15	0.025		0.0870		0.029		0.0828	17	137
+1 +224 0.022	20	0.0632	10	0.022	17	0.0877		0.025	18	0.0844	14	136
+2 +224 0.019		0.0641	10	0.019		0.0890		0.022		0.0856	10	135
+10 +226 0.017	17	0.0652	20	0.017	14	0.0901		0.019	16	0.0865	11	135
+16 +234 0.012	13	0.0682	23	0.012	11	0.0934		0.017	15	0.0878	25	135
+15 +242 0.009	11	0.0698	22	0.009	9	0.0958		0.012	11	0.0916	31	134
-3 +249 0.006	8	0.0726	28	0.006	6	0.0991		0.009	9	0.0940	24	135
-8 +239 0.004	4	0.0755	19	0.004	4	0.1012		0.006	5	0.0975	27	134
0.003		0.0765	16	0.003		0.1028		0.004	3	0.0994	17	132
+241 0.003	0	0.0788		0.003	0	0.1052		0.003		0.1010	17	
								0.003		0.1029		131

TABLE VII

SERIES II DAYS AGED = 7

	0% SLAG		40% SLAG		60% SLAG	
	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)
	182.292	0.0000	182.292	0.0000	182.292	0.0000
	99.432	0.0000	99.432	0.0000	97.948	0.0010
	80.521	0.0005	81.019	0.0000	80.031	0.0010
	55.147	0.0005	55.380	0.0000	54.688	0.0015
	41.799	0.0010	41.667	0.0017	41.535	0.0021
	33.740	0.0010	33.568	0.0023	33.482	0.0026
	28.287	0.0010	28.165	0.0023	28.045	0.0031
	24.351	0.0010	24.261	0.0023	24.162	0.0032
	21.376	0.0010	21.307	0.0023	21.204	0.0036
29	19.049	0.0010	18.994	0.0023	18.898	0.0039
+2 24	18.229	0.0015	18.204	0.0023	18.116	0.0039
+17 31	5.058	0.0055	5.056	0.0032	5.049	0.0086
+39 41	2.936	0.0060	2.936	0.0044	2.933	0.0101
+45 70	2.069	0.0068	2.068	0.0063	2.067	0.0138
+70 86	1.597	0.0078	1.597	0.0121	1.596	0.0164
	1.096	0.0095	1.096	0.0162	0.835	0.0247
+53 140	0.835	0.0107	0.835	0.0202	0.565	0.0284
-6 134	0.565	0.0145	0.565	0.0248	0.427	0.0315
+10 134	0.427	0.0181	0.427	0.0315	0.343	0.0339
+14 149	0.343	0.0190	0.343	0.0329	0.265	0.0367
	0.287	0.0201	0.287	0.0352	0.247	0.0372
-10 148	0.247	0.0224	0.247	0.0370	0.216	0.0385
-11 134	0.216	0.0246	0.216	0.0387	0.192	0.0397
-13 137	0.192	0.0260	0.192	0.0401	0.173	0.0409
+41 126	0.173	0.0283	0.173	0.0422	0.087	0.0505
+74 178	0.087	0.0327	0.087	0.0543	0.058	0.0564
+22 200	0.058	0.0364	0.058	0.0604	0.044	0.0599
+3 200	0.044	0.0399	0.044	0.0644	0.035	0.0631
+8 203	0.035	0.0428	0.035	0.0670	0.029	0.0657
+10 208	0.029	0.0449	0.029	0.0690	0.025	0.0677
+11 213	0.025	0.0464	0.025	0.0705	0.022	0.0696
+12 219	0.022	0.0477	0.022	0.0716	0.019	0.0714
+6 225	0.019	0.0489	0.019	0.0731	0.017	0.0723
+23 225	0.017	0.0498	0.017	0.0737	0.012	0.0779
+41 248	0.012	0.0531	0.012	0.0780	0.009	0.0816
+51 266	0.009	0.0550	0.009	0.0826	0.006	0.0870
+41 299	0.006	0.0572	0.006	0.0858	0.004	0.0909
+14 307	0.004	0.0602	0.004	0.0901	0.003	0.0949
	0.003	0.0627	0.003	0.0941	0.003	0.0980
313	0.003	0.0667	0.003	0.0988		

TABLE VIII

SERIES II DAYS AGED = 14

0% SLAG		40% SLAG		60% SLAG	
PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)
182.292	0.0000	182.292	0.0000	182.292	0.0000
97.948	0.0012	97.948	0.0012	97.948	0.0012
80.031	0.0012	79.545	0.0018	79.066	0.0023
54.688	0.0018	54.461	0.0024	54.236	0.0029
41.535	0.0023	41.404	0.0030	41.404	0.0029
33.482	0.0029	33.397	0.0036	33.397	0.0035
28.045	0.0035	28.045	0.0036	28.045	0.0035
24.127	0.0041	24.171	0.0036	24.149	0.0038
21.169	0.0047	21.238	0.0036	21.204	0.0040
18.858	0.0053	18.939	0.0036	18.912	0.0040
18.054	0.0058	18.128	0.0042	18.103	0.0046
5.044	0.0067	5.050	0.0049	5.048	0.0087
2.932	0.0075	2.934	0.0058	2.933	0.0103
2.066	0.0087	2.067	0.0073	2.067	0.0136
1.595	0.0109	1.596	0.0090	1.596	0.0171
1.096	0.0132	1.096	0.0112	1.096	0.0197
0.835	0.0140	0.835	0.0153	0.835	0.0224
0.565	0.0187	0.565	0.0234	0.565	0.0258
0.427	0.0208	0.427	0.0263	0.427	0.0277
0.343	0.0236	0.343	0.0288	0.343	0.0291
0.287	0.0251	0.287	0.0313	0.287	0.0302
0.247	0.0272	0.247	0.0326	0.247	0.0305
0.216	0.0288	0.216	0.0385	0.216	0.0319
0.192	0.0295	0.192	0.0400	0.192	0.0327
0.173	0.0304	0.173	0.0414	0.173	0.0334
0.099	0.0328	0.087	0.0455	0.087	0.0384
0.087	0.0349	0.058	0.0491	0.058	0.0437
0.058	0.0362	0.044	0.0527	0.044	0.0472
0.044	0.0384	0.035	0.0569	0.035	0.0507
0.035	0.0408	0.029	0.0590	0.029	0.0538
0.029	0.0431	0.025	0.0606	0.025	0.0562
0.025	0.0447	0.022	0.0620	0.022	0.0583
0.022	0.0462	0.019	0.0629	0.019	0.0600
0.019	0.0474	0.017	0.0638	0.017	0.0618
0.017	0.0484	0.012	0.0677	0.012	0.0675
0.012	0.0525	0.009	0.0677	0.009	0.0719
0.009	0.0552	0.006	0.0769	0.007	0.0754
0.006	0.0590	0.004	0.0811	0.006	0.0783
0.004	0.0621	0.003	0.0878	0.004	0.0853
0.003	0.0655	0.003	0.0935	0.003	0.0907
0.003	0.0739			0.003	0.0951

TABLE IX

SERIES II DAYS AGED = 30

		0% SLAG		40% SLAG		60% SLAG		
		PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	PORE SIZE (UM)	ABSOLUTE PENETRATION (CC/G)	
		182.292	0.0000	182.292	0.0000	182.292	0.0000	
		99.432	0.0000	99.432	0.0000	97.948	0.0011	
		81.019	0.0000	81.019	0.0000	79.545	0.0017	
		55.330	0.0000	54.916	0.0011	54.461	0.0022	
		42.067	0.0000	41.733	0.0014	41.404	0.0028	
		33.397	0.0035	33.654	0.0016	33.482	0.0028	
		28.045	0.0035	28.195	0.0019	28.045	0.0033	
		24.149	0.0037	24.261	0.0022	24.171	0.0033	
	-13	21.169	0.0046	21.307	0.0022	21.238	0.0033	
0	-13	18.885	0 0.0046	18.994	0.0022	18.939	0 0.0033	
-5	-13	18.103	1 0.0046	18.204	0.0022	18.154	3 0.0033	72
		5.048	16 0.0049	2.936	0.0052	4.415	8 0.0039	~
		2.933	22 0.0079	2.068	0.0069	2.513	18 0.0050	
-6	-18	2.067	23 0.0093	1.597	0.0080	2.068	24 0.0075	71
-35	-19	1.096	26 0.0125	1.096	0.0102	1.527	15 0.0089	
		0.835	37 0.0145	0.835	0.0119	1.096	19 0.0106	85
-38	-53	0.565	42 0.0200	0.565	0.0163	0.779	20 0.0127	
+6	-57	0.427	23 0.0229	0.427	0.0186	0.565	22 0.0147	74
+9	-47	0.343	15 0.0247	0.343	0.0205	0.427	26 0.0172	75
-6	-48	0.287	13 0.0259	0.287	0.0224	0.343	17 0.0200	81
-6	-53	0.247	10 0.0273	0.247	0.0238	0.287	10 0.0211	81
-3	-54	0.216	7 0.0279	0.216	0.0246	0.247	7 0.0220	81
-2	-56	0.192	6 0.0287	0.192	0.0252	0.216	5 0.0225	81
-4	-56	0.173	9 0.0292	0.173	0.0258	0.192	5 0.0231	81
		0.116	24 0.0306	0.116	0.0280	0.173	25 0.0236	91
+19	-60	0.087	21 0.0341	0.087	0.0291	0.087	38 0.0281	82
+40	-37	0.058	8 0.0349	0.056	0.0316	0.058	26 0.0312	89
+29	-20	0.044	10 0.0357	0.044	0.0332	0.044	25 0.0337	94
+18	-8	0.035	16 0.0370	0.034	0.0351	0.035	25 0.0362	92
+7	-2	0.029	17 0.0389	0.029	0.0366	0.029	22 0.0387	99
+10	+1	0.025	13 0.0405	0.025	0.0382	0.025	18 0.0406	100
+13	+8	0.022	8 0.0415	0.022	0.0388	0.022	17 0.0423	102
+8	+19	0.019	9 0.0421	0.019	0.0404	0.019	13 0.0440	105
+34	+16	0.017	20 0.0433	0.018	0.0417	0.017	37 0.0449	104
+55	+53	0.012	26 0.0462	0.012	0.0468	0.012	54 0.0515	111
+61	+71	0.009	28 0.0486	0.009	0.0502	0.009	58 0.0557	115
+80	+114	0.006	32 0.0518	0.006	0.0558	0.006	71 0.0632	122
+46	+151	0.004	34 0.0550	0.004	0.0618	0.004	67 0.0699	127
		0.003	50 0.0596	0.003	0.0679	0.003	55 0.0766	
	+160	0.003	0.0650	0.003	0.0740	0.003	0.0810	125

TABLE X

CANMET Series I

Results of Porosimeter Studies

% Slag	Cure Time (days)	Porosity (%)	Density (g/cc)	Absolute Penetration (cc/g)	Pore Size at		
					20% Pore Vol. (μm)	50% Pore Vol. (μm)	80% Pore Vol. (μm)
0	3	19.14	2.54	0.0933	1.35	0.17	0.034
	7	15.44	2.49	0.0776	0.65	0.076	0.015
	14	14.65	2.47	0.0695	0.47	0.079	0.010
	30	13.25	2.42	0.0638	1.03	0.103	0.006
	91	13.07	2.48	0.0607	1.10	0.14	0.006
40	3	19.58	2.53	0.0964	1.75	0.26	0.035
	7	19.28	2.53	0.0942	2.13	0.15	0.017
	14	18.20	2.54	0.0876	0.73	0.079	0.008
	30	15.69	2.45	0.0759	0.80	0.040	0.006
	91	17.22	2.48	0.0840	0.65	0.038	0.005
60	3	23.32	2.59	0.1183	5.15	0.50	0.039
	7	20.06	2.55	0.0986	1.35	0.13	0.013
	14	18.85	2.50	0.0930	1.09	0.049	0.008
	30	16.47	2.48	0.0791	0.35	0.024	0.006
	91	17.76	2.48	0.0850	0.65	0.021	0.005

TABLE XI

CANMET Series II

Results of Porosimeter Study

% Slag	Cure Time (days)	Porosity (%)	Density (g/cc)	Absolute Penetration (cc/g)	Pore Size at 20% Pore Vol. (μm)	Pore Size at 50% Pore Vol. (μm)	Pore Size at 80% Pore Vol. (μm)
0	3	16.62	2.54	0.0788	0.56	0.10	0.022
	7	14.94	2.63	0.0667	0.63	0.083	0.012
	14	15.26	2.48	0.0739	0.76	0.05	0.0058
	30	14.47	2.61	0.0650	0.94	0.075	0.0056
40	3	21.73	2.64	0.1052	1.35	0.24	0.035
	7	20.31	2.58	0.0988	0.83	0.109	0.011
	14	19.14	2.53	0.0935	0.70	0.07	0.006
	30	15.48	2.47	0.074	0.65	0.027	0.005
60	3	20.93	2.57	0.1029	2.19	0.29	0.032
	7	19.94	2.54	0.0980	1.17	0.10	0.011
	14	19.61	2.56	0.0951	1.30	0.043	0.007
	30	16.86	2.50	0.0810	0.50	0.025	0.0052

FIGURE 1

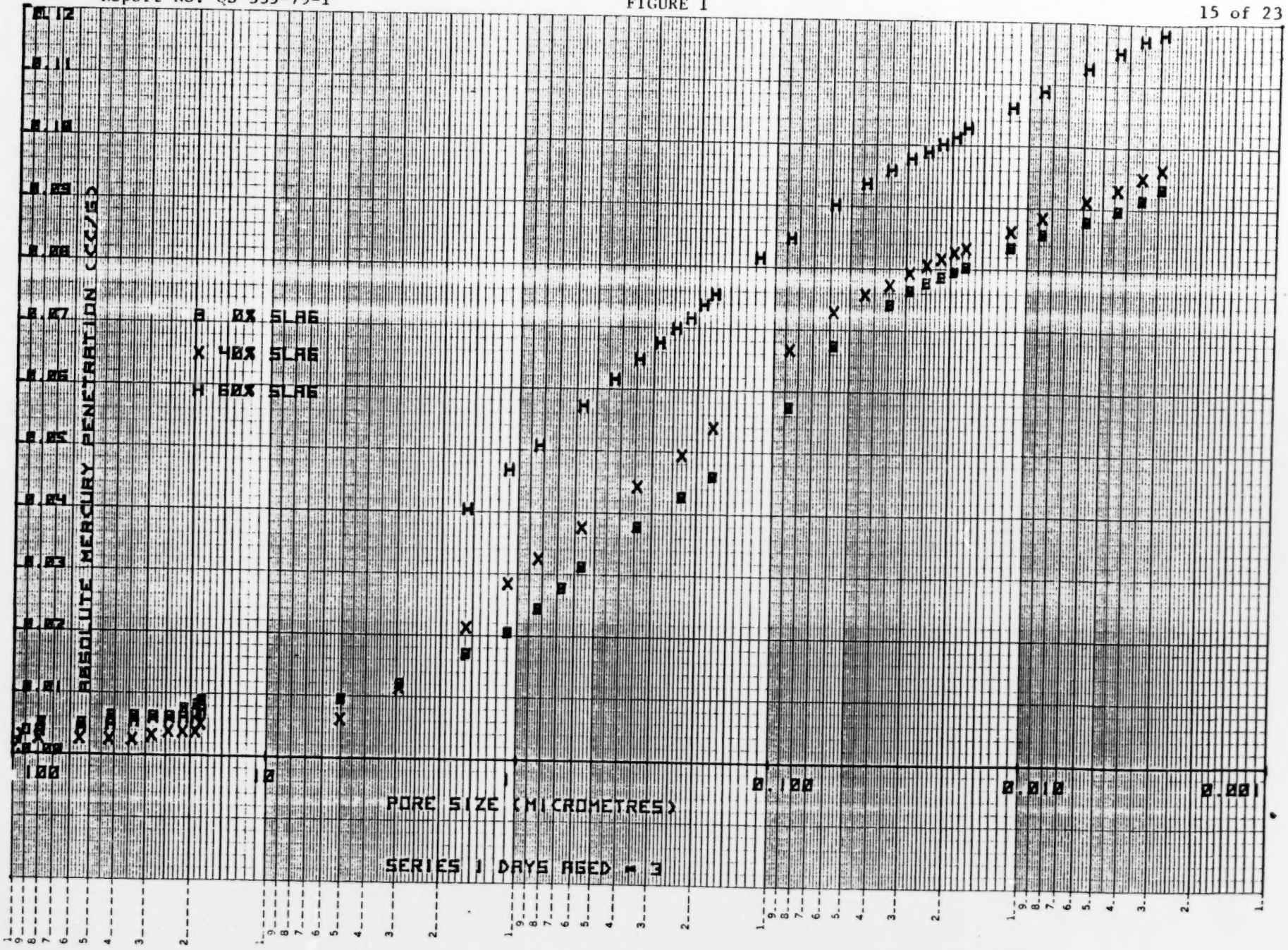

0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
ABSOLUTE MERCURY PENETRATION (CC/GM)
B 0% SLAG
X 40% SLAG
H 60% SLAG
100
10
1
0.100
0.010
0.001
PORE SIZE (MICROMETRES)
SERIES 1 DAYS AGED = 3
46 6210
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN USA

FIGURE 2

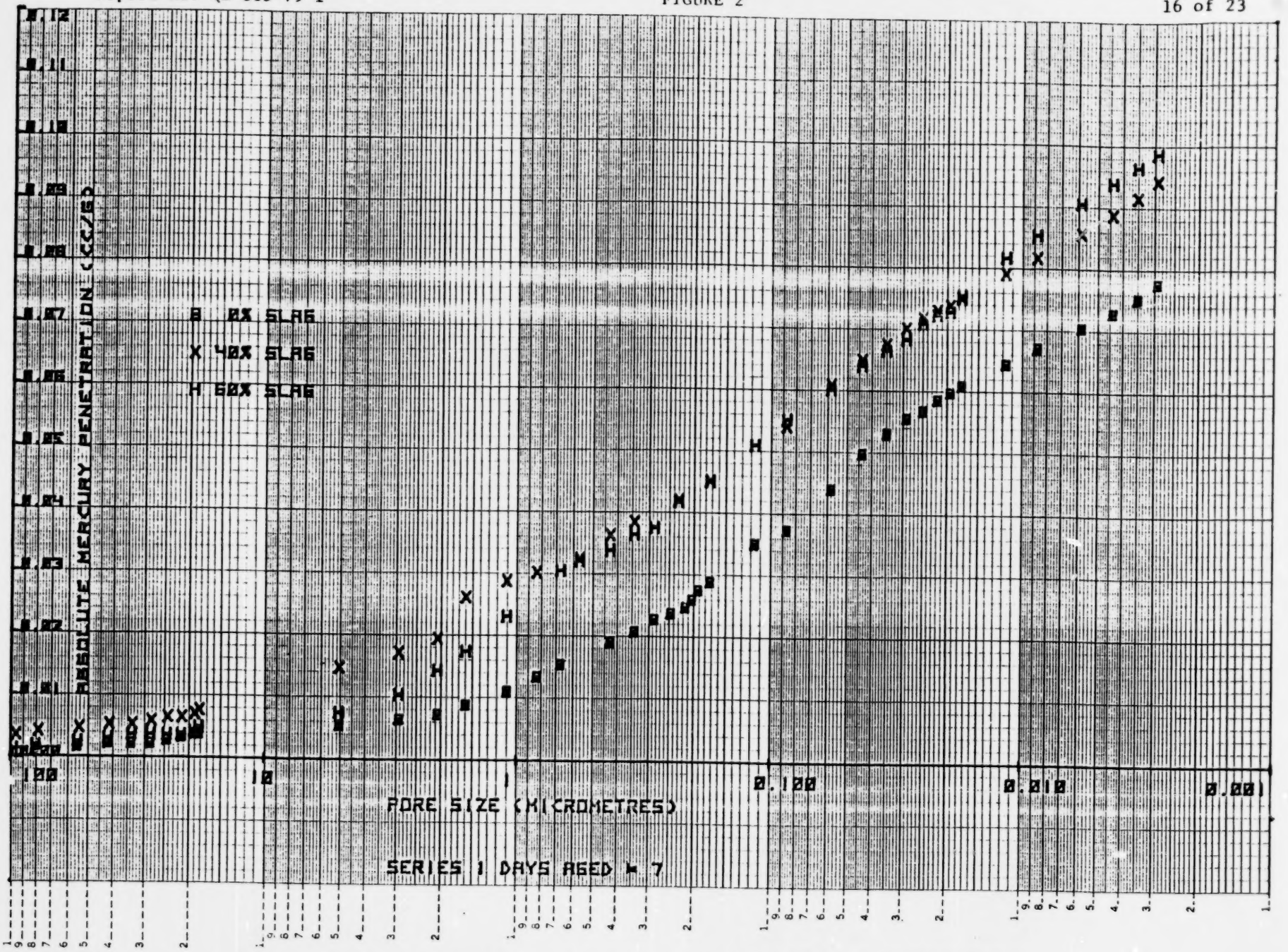

0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
CX ABSOLUTE MERCURY PENETRATION (CC/GM)
B 0X SLAG
X 40X SLAG
H 60X SLAG
100
10
1
0.100
0.010
0.001
PORE SIZE (MICROMETRES)
SERIES 1 DAYS AGED = 7
46 6210
KEUFFEL & ESSER CO. MADE IN U.S.A.
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS

FIGURE 3

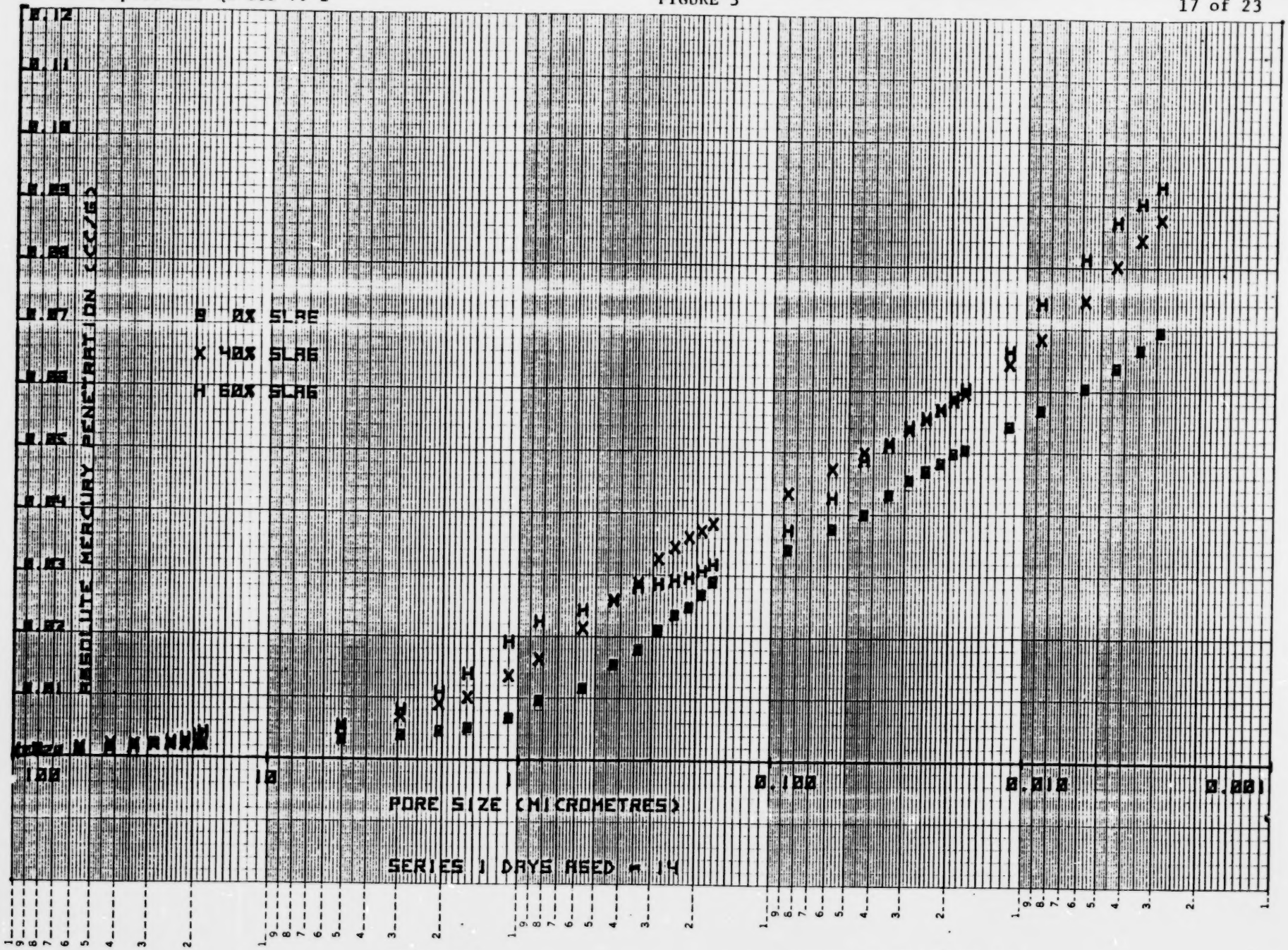

0 0% SLAG
X 40% SLAG
H 60% SLAG
ABSOLUTE MERCURY PENETRATION (CC/GM)
PORE SIZE (MICROMETRES)
100
10
1
0.100
0.010
0.001
SERIES 1 DAYS AGED = 14
KEUFFEL & ESSER CO
46 6210

FIGURE 4

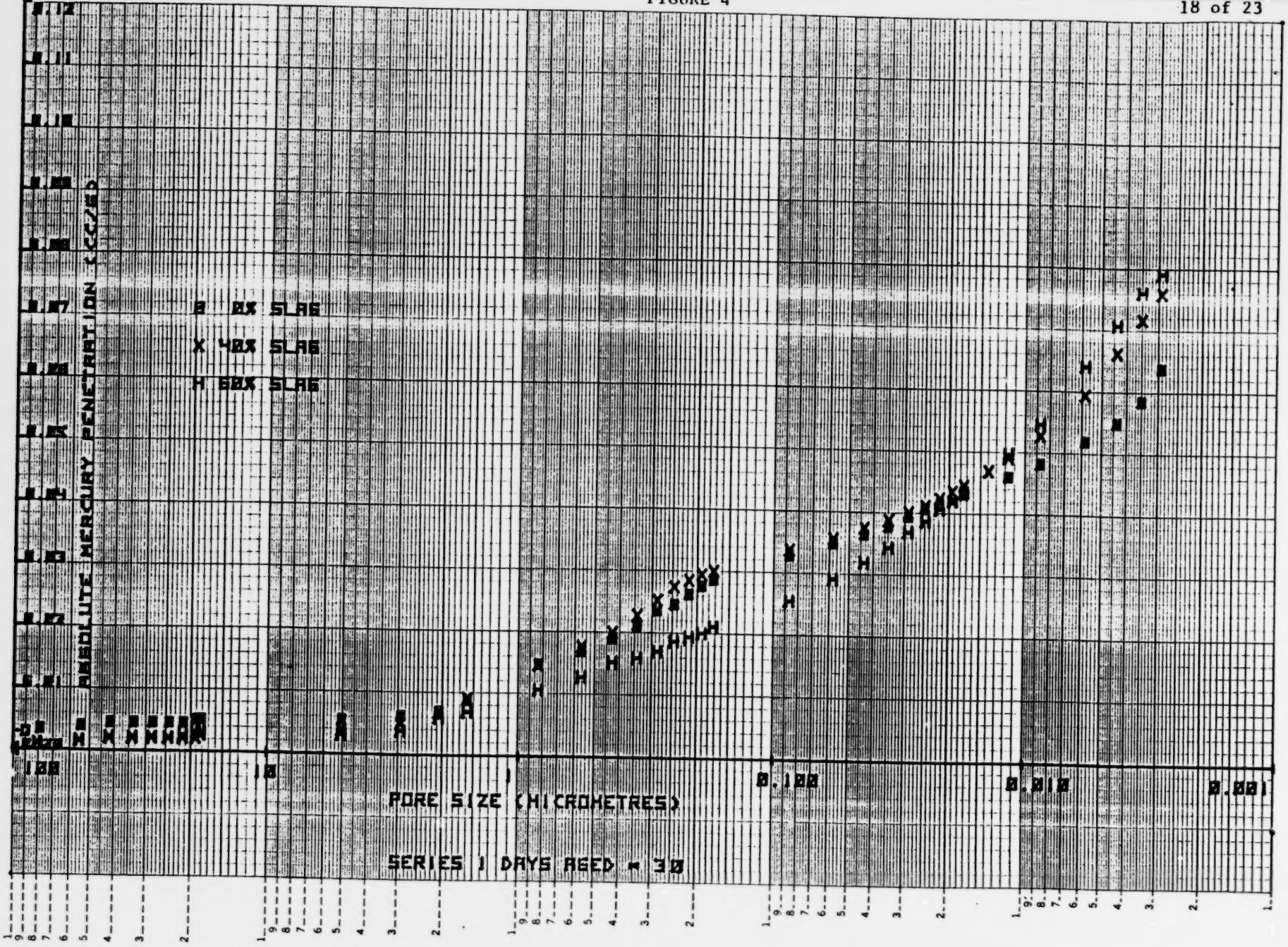
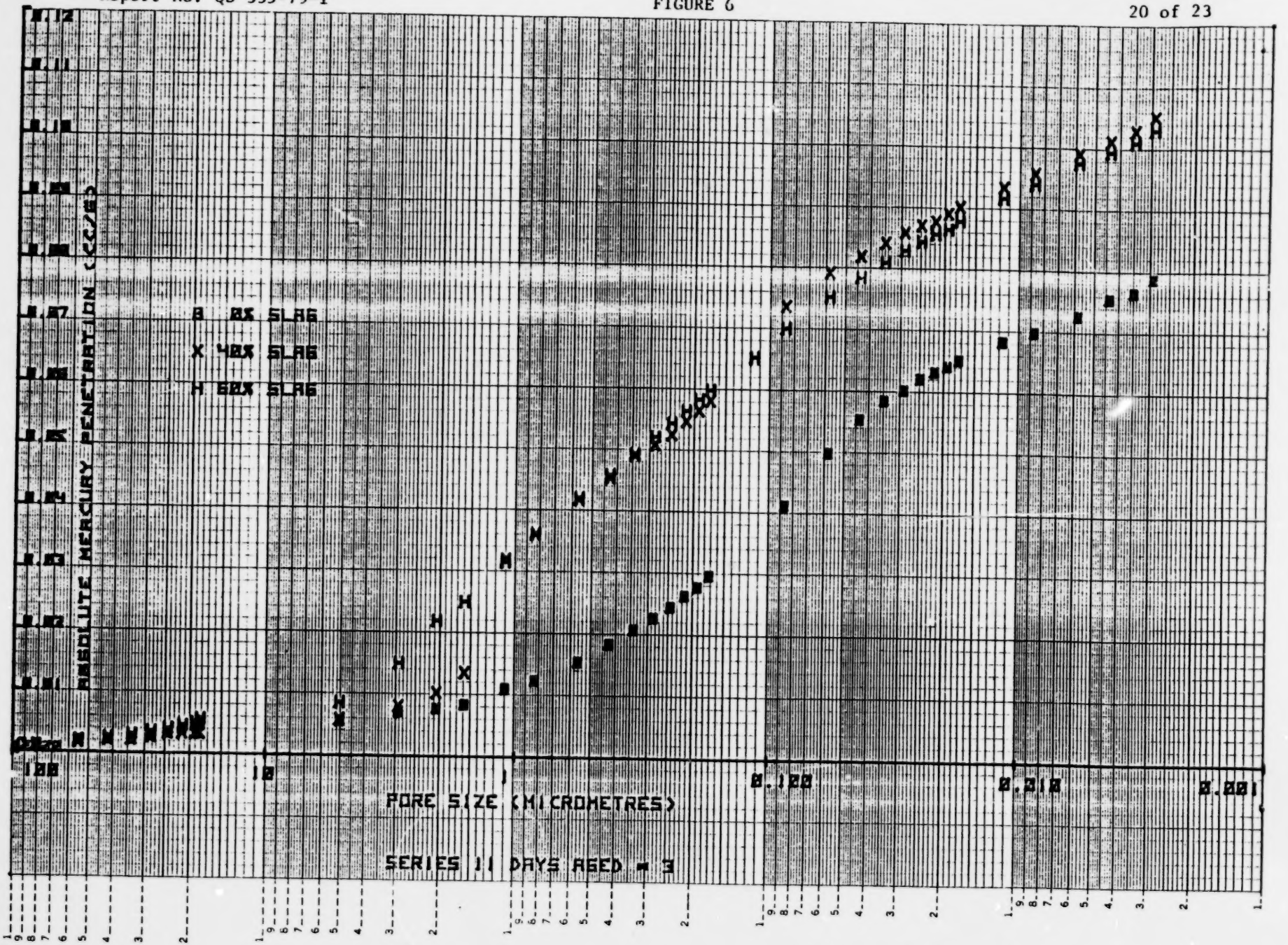
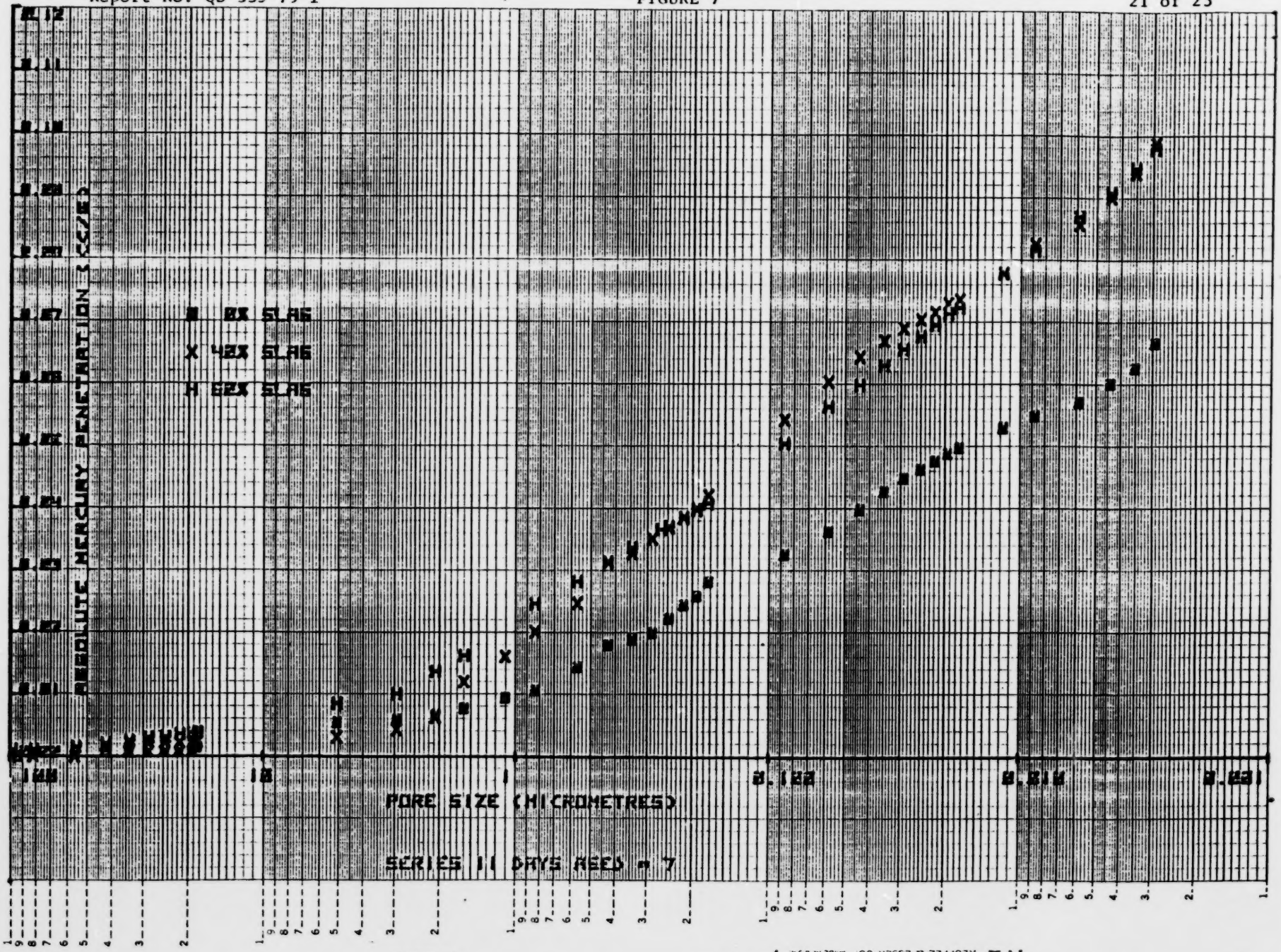

ABSOLUTE MERCURY PENETRATION (cc/gm)
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0 0X SLAG
X 40X SLAG
H 60X SLAG
100
10
1
0.100
0.010
0.001
PORE SIZE (MICROMETRES)
SERIES 1 DAYS AGED = 30
46 6210
K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.

FIGURE 5

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.
46 6210
SERIES 1 DAYS AGED = 81
PORE SIZE (MICROMETRES)
ABSOLUTE MERCURY PENETRATION (CC/GM)
B EX SLAB
X YBX SLAB
H BBX SLAB

FIGURE 6


ABSOLUTE MERCURY PENETRATION (cc/g)
B 80X SLAG
X 40X SLAG
H 60X SLAG
PORE SIZE (MICROMETRES)
SERIES 11 DAYS AGED = 3
46 6210
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN USA


ABSOLUTE MERCURY PENETRATION (CC/GM)
0.12
0.11
0.10
0.09
0.07
0.06
0.04
0.03
0.01
0.000
0.122
0.014
0.031
100
10
1
PORE SIZE (MICROMETRES)
SERIES II DAYS AGED = 7
0 SX SLAG
42X SLAG
62X SLAG
46 6210
KEUFFEL & ESSER CO MADE IN U.S.A.
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS

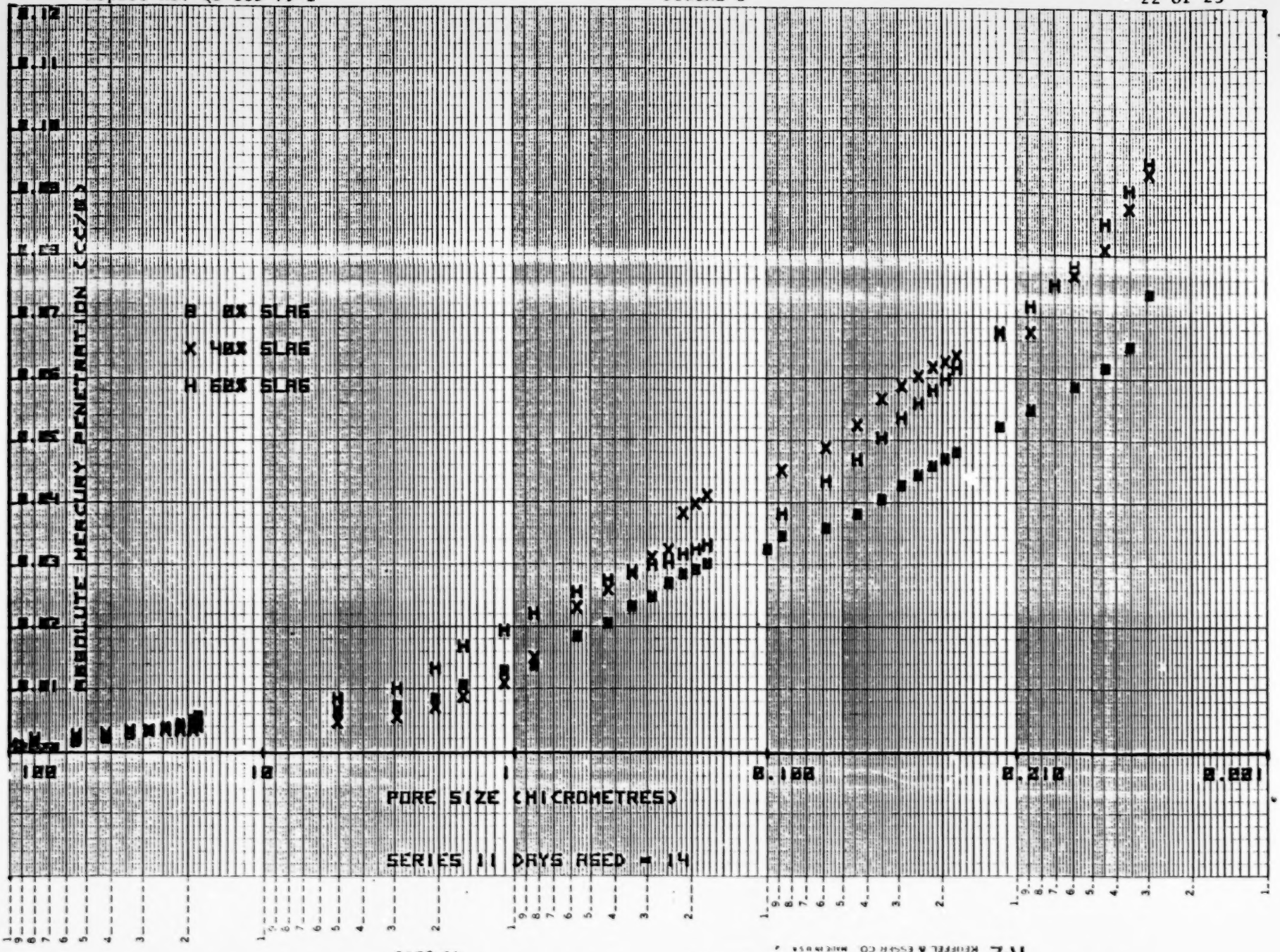
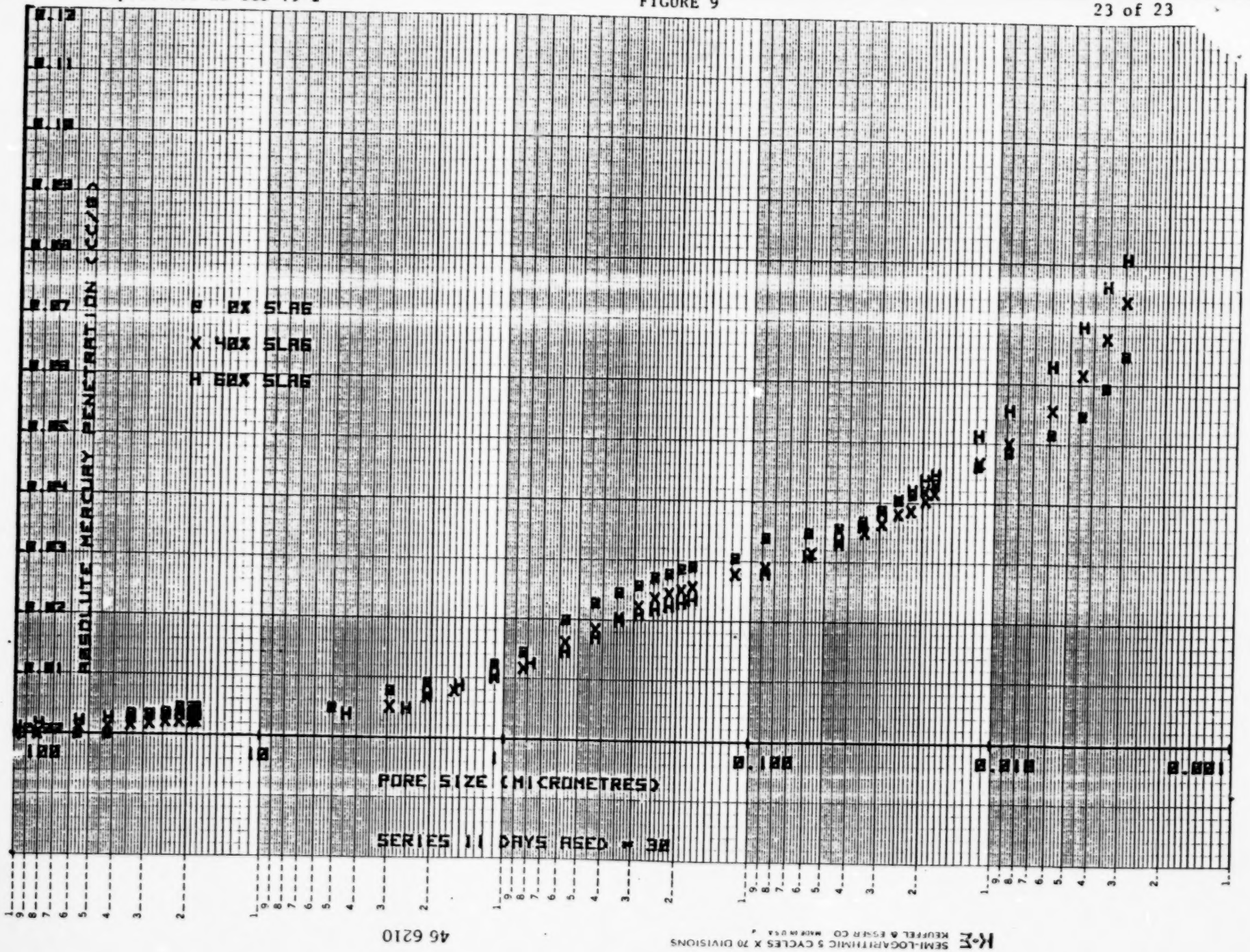

ABSOLUTE MERCURY PENETRATION (CC/GM)
B 80X SLAG
X 40X SLAG
H 60X SLAG
100
10
1
0.100
0.010
0.001
PORE SIZE (MICROMETRES)
SERIES 11 DAYS AGED = 14
46 6210
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 9


0 0X SLAG
X 40X SLAG
H 60X SLAG
ABSOLUTE MERCURY PENETRATION (CC/G)
PORE SIZE (MICROMETRES)
SERIES 11 DAYS AGED = 30
0.100
0.010
0.001
46 6210
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO

POOR

QUALITY

ORIGINAL